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Postoperative analgesic effect of bupivacaine infiltration following lumbar disc surgery

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ABSTRACT

Objectives: Effectiveness of 0.5% bupivacaine administered onto dura, under lumbar superficial fascia and subcutaneous tissue on postoperative pain control was analyzed in patients undergoing lumbar microdiscectomy.
Methods: Sixty adult patients scheduled to undergo elective, single-level lumbar discectomy were randomly divided into four groups: the control group (Control), the subcutaneous tissue group (Group C), which received 20 ml of 0.5% bupivacaine in the subcutaenous tissue, the superficial fascia group (Group F), which received 12 ml bupivacaine in the subcutaneous tissue and 8 ml in the space below the lumbar superficial fascia, and the dura group (Group D), which received a total of 20 ml (100 mg) of bupivacaine, consisting of 10 ml in the subcutaneous tissue, 8 ml in the space below the lumbar superficial fascia, and 2 ml on the dura. Visual Analog Scale Values (VAS) on postoperative 0, 15, 30, 45 minutes, at 1, 2, 4, 6, 12 and 24th hour and time of the first analgesic need were evaluated for all patients and recorded.
Results: While mean VAS value measured at min 0 (as soon as the patient awakened) was 2.3 ± 1.2 in Group D; it was 2.7 ± 0.9 in Group C; 2.7 ± 1.0 in Group F and 3.1 ± 0.6 in control group (p = 0.232). At the end of 1th hour, mean VAS value was recorded as 2.8 ± 1.0 in Group D; 3.6 ± 1.5 in Group C; 3.6 ± 1.1 in Group F and 4.4 ± 1.1 in control group (p = 0.005). In Group D, 0.5% bupivacaine administered as 2, 8, 10 ml onto dura, fascia and subcutaneously was detected to provide significantly lower VAS values and significantly longer first analgesic need time.
Conclusions: 0.5% bupivacaine administered onto dura, under lumbar superficial fascia and in subcutaneous tissue was detected to be a simple, effective and safe method in lumbar microdiscectomy operations.

Keywords: lumbar microdisectomy, bupivacaine, pain, infiltration analgesia

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Microdiscectomy is performed on patients who have been diagnosed with lumbar disc hernia after experiencing low back pain and radicular pain, who have not recovered after conservative treatment, and who have neurologic deficits in addition to their physical complaints [1]. However, despite the modern surgical techniques developed within the past 20 years, 30-70% of patients have been shown to continue to complain of moderate to severe low back pain and radicular pain following lumbar disc surgery. Identifying effective pain control measures remains important for these patients [2, 3].

The severity of postoperative pain varies depending on the magnitude of the surgical trauma, the anesthesia approach, the patient's physiological, psychological, and emotional status, as well as the

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socio-cultural structures of the patient. Surgical trauma and related pain lead to a physiological stress response and, consequently, pulmonary, cardiovascular, gastrointestinal, metabolic, and neuroendocrinological complications [4, 5]. Thus, appropriate and sufficient postoperative pain treatment is an important factor for facilitating postoperative recovery, shortening hospital stay duration, and reducing treatment costs [6-8].

Local anesthetic applications for preoperative or postoperative incisional pain are known to be performed for lumbar disc surgery in various surgical disciplines [9-12]. We analyzed the effect of local bupivacaine, an amide class, potent, long-acting agent that significantly separates sensory and motor block, administrations on postoperative pain [13].

METHODS

A total of 60 adult patients aged between 20-58 years, who scheduled to undergo elective single-level lumbar discectomy operation for the first time, of whom 39 (65%) were in ASA I and 21 (35%) were in ASA II risk group were included in the study after informed consent and ethics committee approval had been obtained. The patients who had significant cardiovascular, pulmonary, hepatic, renal, neurologic, psychiatric or metabolic diseases and who had allergy to the local anesthetic were excluded from the study. The patients were instructed about Visual Analogue Scale (VAS) (0 = no pain, 10 = overwhelming pain) which is composed of a 10 cm of line indicating pain severity. The patients were monitored for electrocardiography (ECG), non-invasive blood pressure and oxygen saturation after they had been taken to operating table.

The patients were allocated to 4 groups according to postoperative analgesia. Each group was administered 20 ml (100 mg) of 0.5% bupivacaine. Following standard general anesthesia administration, all cases were performed single-level partial hemilaminectomy and lumbar microdiscectomy operation after median 2 cm midline incision. Patients in Group C were administered 20 ml of 0.5% bupivacaine into only subcutaneous tissue, Group F were administered 12 ml bupivacaine into subcutaneous tissue and 8 ml in space below lumbar superficial fascia at the end of the operation, Group D were administered a total of 20 ml (100 mg) bupivacaine of which 10 ml into subcutaneous tissue, 8 ml in space below lumbar superficial fascia and 2 ml onto dura after hemostasis had been provided. No drug was administered in control group. Afterwards fascia, subcutaneous tissue and skin were closed in accordance with anatomic structure and the operation was terminated. VAS scores on postoperative 0, 15, 30 and 45 minutes, at 1, 2, 4, 6, 12 and 24th hour were evaluated for all patients when the patient was unwitting and results were recorded. It was planned to administer diclofenac sodium 75 mg via intramuscular route when VAS value >5 or the patient demanded analgesic for his/her pain and metoclopramid via intravenous route when the patient had nausea and vomiting. Analgesia time was determined by recording the time of the first analgesic need. Complications developing due to intraoperative and postoperative local anesthetic use (hallucination, respiratory depression, sedation, nausea, vomiting, hypotension and bradycardia) were recorded.

Statistical Analysis

Statistical analyses were done using SPSS (Statistical Package for Social Sciences) for Windows 15.0 program. Pearson chi-square test was used for comparison of qualitative data beside descriptive statistical methods (frequency, percent, mean, standard deviation). Kolmogorov-Smirnov test was used for normality distribution. Mann-Whitney U test was used for inter-group comparisons in case of presence of two groups for comparison of quantitative data. When there were four groups in comparison of quantitative data, Kruskal-Wallis test was used for inter-group comparisons, Mann-Whitney U test was used for detection of the group causing difference. Friedman test was used for in-group comparisons for 10 measurements, Wilcoxon test was used for detection of the group causing difference. Results were evaluated as 95% confidence interval and a p level of < 0.05.

RESULTS

Of the patients included in the study, 31 (51.7%) were female and 29 (48.3%) were male with mean age of 43.25 ± 8.93 years. A statistically significant

Table 1. Duration of the first analgesic need according to groups

Duration of the first analgesic need **(min)**				
Group C	**Group F**	**Group D**	**Control**	
Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	***p* value**
221.3 ± 188.3	376.7 ± 262.6	475.0 ± 245.8	94.0 ± 54.8	0.001

SD = standard deviation, Group C = subcutaneous tissue group, Grup F = superficial fascia group, Group D = dura group

difference was not found between groups with regard to demographic data of the patients ($p > 0.05$). Mean time of first analgesic need was significantly lower in control group compared to Group D and Group F ($p < 0.01$). The mean time of first analgesic need was found statistically significantly higher in Group D compared to Group C ($p < 0.05$) (Table 1).

Total amount of analgesic use in control group was found statistically significantly higher compared to Group C, Group F and Group D ($p < 0.01$). Mean amount of total analgesic was found lower in Group D compared to Group C ($p < 0.05$) (Figure 1).

A statistically significant difference was not detected between groups when systolic and diastolic arterial blood pressure, respiratory rate, heart beat and oxygen saturation were evaluated at different times ($p > 0.05$). Vomiting was observed during postoperative follow ups in two cases in each of Group C and Group D, in one case in each of Group F and control group.

Differences in the VAS were statistically significant at all postoperative intervals. While mean VAS scores at min 0 were 2.3 ± 1.2 in Group D; they were 2.7 ± 0.9 in Group C; 2.7 ± 1.0 in Group F and 3.1 ± 0.6 in control group ($p = 0.232$). There was a statistically significant difference between groups with regard to VAS values at 1th hour ($p < 0.01$). According to this, mean VAS scores at the end of 1st hour were found as 2.8 ± 1.0 in Group D; 3.6 ± 1.5 in Group C; 3.6 ± 1.1 in Group F and 4.4 ± 1.1 in control group ($p = 0.005$).

Mean VAS value in Group D at particularly 1th hour was found extremely lower compared to control group and significantly lower compared to Group F and Group C ($p < 0.01$).

VAS values were seen to go low until the end of 24th hour following the first analgesic administration

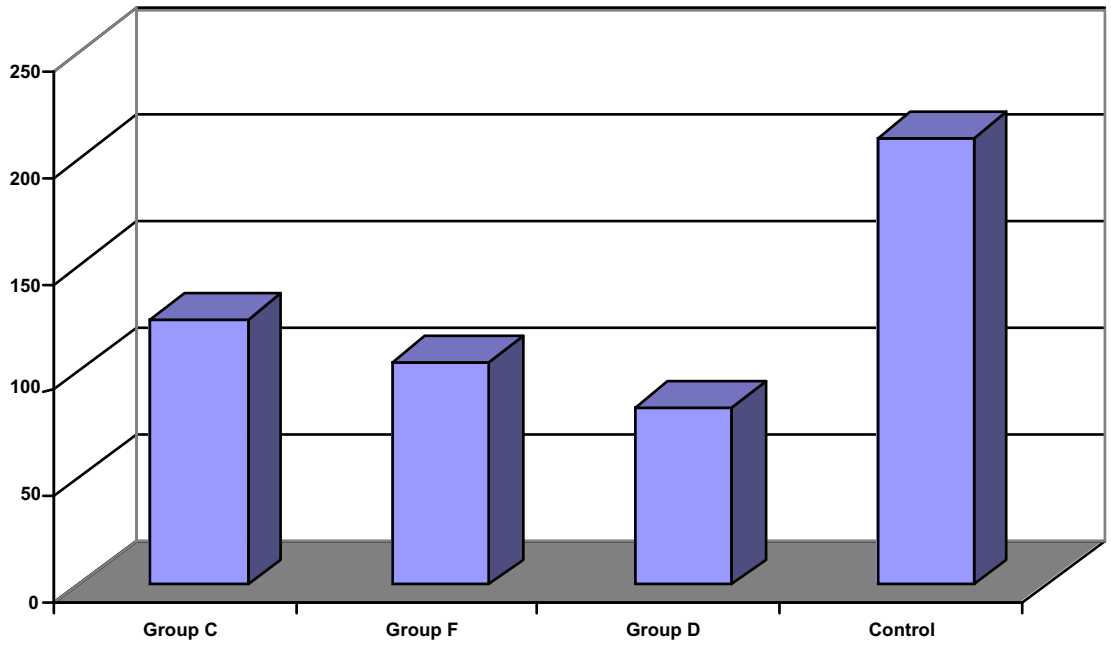

Figure 1. Distribution of total amount of analgesic according to groups.

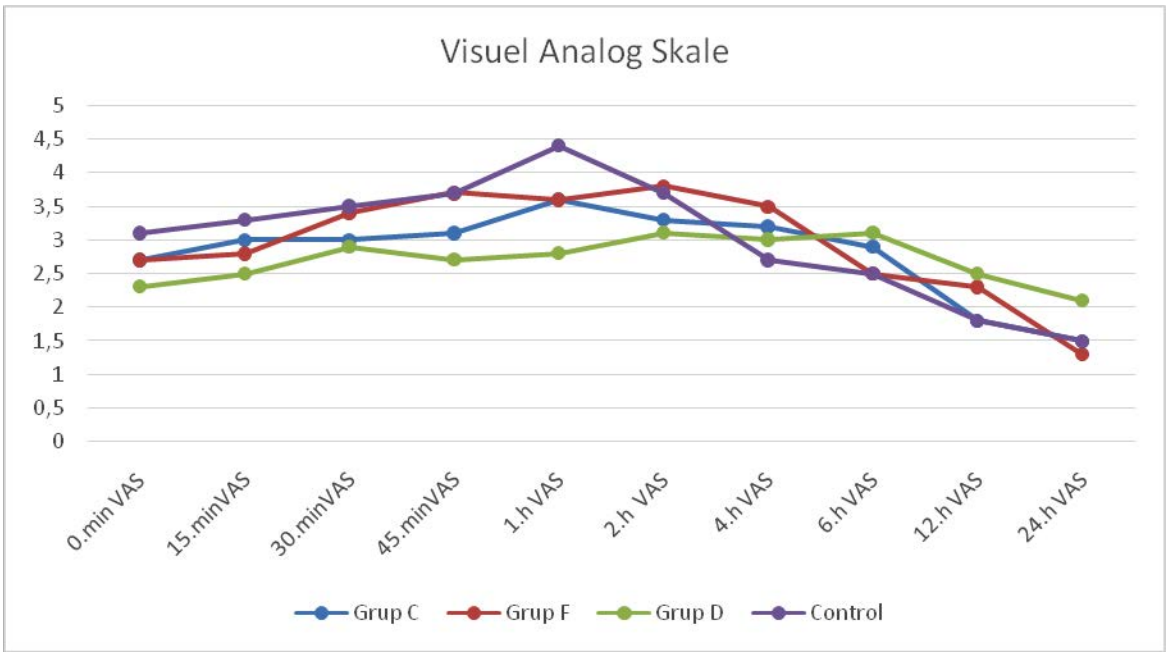

Figure 2. Change of VAS value according to time for each group.

in control group. At the end of 24th hour, although mean VAS value was found mildly higher in Group D compared to other groups, the difference was not statistically significant (P = 0,166). Alteration in VAS according to time is graphed in Figure 2.

DISCUSSION

Pain and burning sensation at the incision site are most prominent in the early postoperative period after lumbar disc operations [14]. The pain experienced during this early period is related to incision length and the duration of retraction. Kotil *et al*. [15] reported that continuous retraction increased serum creatine phosphokinase levels and postoperative pain when compared to intermittent retraction during discectomy operations, and Shin *et al*. [16] reported that the microendoscopic technique reduced postoperative pain by hindering iatrogenic tissue injury. These results suggest that the tissue injury that occurs during microdiscectomy may be related to postoperative pain. Moreover, moderate to severe pain following surgery may have negative effects on the pulmonary system (e.g., atelectasis, pulmonary edema, or hypoxemia) and cardiovascular system (e.g., arrhythmia, increased systemic vascular resistance, hypertension, or myocardial infarction). Such pain may also increase the risk of thromboembolism due to hindered early mobilization [4, 5, 7, 9, 17]. On the other hand, effective postoperative pain reduces morbidity and mortality rates [9, 10, 14].

Cherian *et al*. [18] reported that 0.375% bupivacaine applied to the wound in lumbar discectomy operations provided analgesia within the first nine postoperative hours in all cases. Ersayli *et al*. [9] reported a first analgesia need time similar to ours with a bupivacaine and steroid combination in lumbar discectomy operations. In their study investigating the influence of 0.25% bupivacaine, ropivacaine, and saline administered to the subcutaneous tissue and paraspinal muscles during wound closure following lumbar discectomy, Hernandez-Palazon *et al*. [19] reported a longer analgesia time in the bupivacaine group compared to the ropivacaine and saline groups.

The recent study by Puffer *et al*. [20] demonstrated that infiltrating 10cc of 0.5% bupivacaine with epinephrine under the skin and 40cc of a 50:50 mixture of liposomal bupivacaine and 0.5% bupivacaine without epinephrine in the subcutaneous tissue significantly decreased the time of intravenous narcotic pain medication. They also reported no significant differences in VAS scores or total morphine equivalents [20]. In a similar vein, Jackson Kim *et al*. [21] reported that liposomal bupivacaine was very

useful for pain control and reduced narcotic need and hospital stay in their studies that compared the local infiltrative effects of liposomal bupivacaine and nonliposomal local anesthetics in patients who underwent transforaminal lumbar interbody fusion.

In our study, we observed that bupivacaine provided significantly lower VAS values in the early postoperative period and significantly longer first analgesic need at a 0.5% concentration and in amounts of 2.8, and 10 ml applied to the dura, fascia, and subcutaneous tissues, respectively. Wound infiltration with bupivacaine resulted in a reduction of analgesic need and postoperative pain without the development of complications. We concluded that bupivacaine applied as doses of 2, 8, and 10 ml at a 0.5% concentration to the dura, fascia, and subcutaneous tissues, respectively, provided effective and safe pain control for the postoperative management of lumbar pain due to incision and retraction during lumbar disc hernia operations.

CONCLUSION

In this study, we aimed to achieve early discharge and early return to normal, daily activities through simple, safe, and inexpensive postoperative pain treatment independent of non-steroidal anti-inflammatory or opioid analgesic side effects by comparing the infiltrative anesthesia effects of bupivacaine in different compartments in lumbar discectomy operations. Wound site infiltration is one of the simplest and most effective ways of managing postoperative pain, and many reports have been published about this topic [9-12]. Bupivacaine, at a concentration of 0.5%,administered to the dura, fascia, and subcutaneous tissue may be used as an effective and safe pain management method following lumbar discectomy operations for patients who suffer gastrointestinal side effects from systemic analgesics.

Conflict of interest

The author disclosed no conflict of interest during the preparation or publication of this manuscript.

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